KROHNE
measure the facts

Ultrasonic gasflowmeters

Application of the latest generation of ultrasonic gasflowmeters

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Ultrasonic gasflowmeters main benefits

- Ulltrasonic flowmeter for gas - OPTISONIC 7300
- Ultrasonic flowmeter for high temperature gas/ steam - OPTISONIC 8300

- **Excellent long term stability**
  - Consistent results over time; 1 month, 1 year, 10 years
  - No moving parts
  - No wear, no re-calibration

- **High performance over a wide measurement range**
  - -30 ..30 m/s (Steam -80..80m/s)
  - Measures from zero
  - 30:1 turndown or better
  - Large variation in gas compositions and densities
  - Large temperature and pressure range
  - Resistant against liquids in the gas

Ultrasone gasflowmeters main benefits

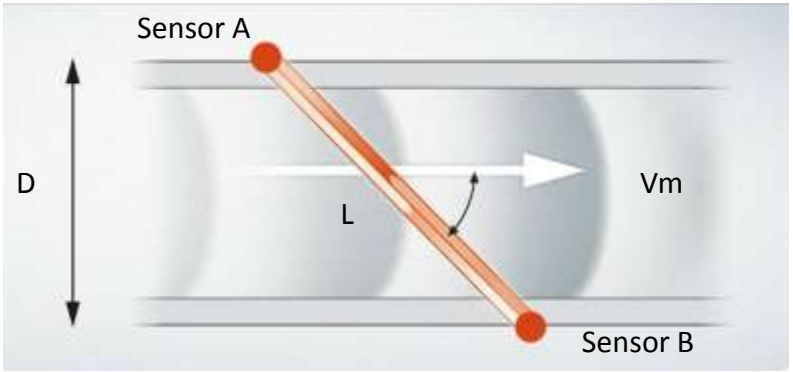
- **Diagnostics to validate flowmeter and process**
  - Detection of operational conditions going out of specification: density, damping, flowspeed, liquids.
  - Detection of external disturbances
- **Integrated flowcomputer**
  - calculation to standard conditions
  - Input of pressure and temperature
- **Maintenance free full bore flowsensor**
  - Solid state: no wear
  - No moving parts
- **Economic alternative for mechanical flow meters**
  - Low investment (capex)
  - Low operational cost (opex)

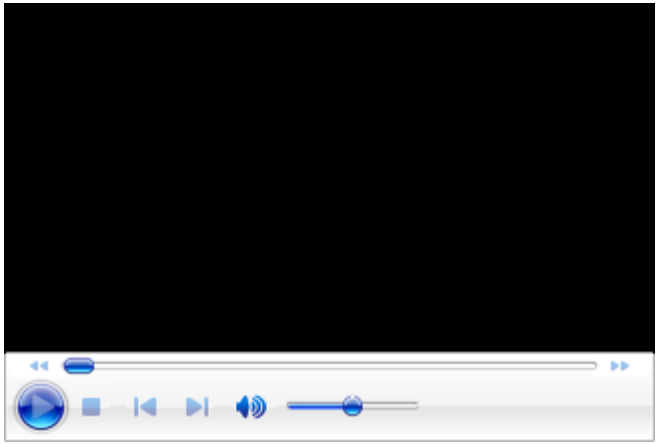
Ultrasone sensor technology

- Special transduser design for gasflowmeters
- Acoustic signal going backwards through the transducer towards the pipe wall is dampened, *killing the crosstalk*
- Use of titanium and high power signal maximizes the acoustic energy into the gas
- 1 of 2 pads flowmeter (high Reynolds values)

Patented design OPTISONIC 7300

UFM: The transit time principle – Independent of the medium!





- Transit Time = Distance/Speed
- Acoustic signals are transmitted and received over the diagonal measurement path
- A sound wave moves faster with the flow than against the flow
- The difference in transit time is directly proportional to the average flow speed of the medium (on measuring path)

Applications: Petrochemical, Refineries

Customer:	BASF
Location:	Antwerp
Process:	Butadiene plant
Medium:	Butane (44)
Flowmeter:	OPTISONIC 7300 C - 30” (DN750)

Butadiene is a raw material that can be used to produce synthetic rubber, among other applications.

Remarks: The plant will have an annual production capacity of 155,000 metric tons → high flow speed (40 m/s)

Challenge: High flowrate
Specific benefits: Large diameter and **no pressure loss**

Applications: Petrochemical, Refineries

Customer:	ORL refinery
Location:	Haifa, Israel
Process:	Hydrocracker
Medium:	**Hydrogen 152 Bar, 175°C**
Flowmeter:	OPTISONIC 7300 F 12” **weld in**

Remarks:

- The OPTISONIC 7300 is weld in to counter the risk of leakage at the process connection
- The solution provided by KROHNE is unique in the world

Specific benefits:

Avoid the risk on breaking impulse lines of DP flowmeters at earthquakes with would cause leakage of hydrogen.

Applications: Petrochemical, Refineries

Customer:	Shell Pernis refinery
Location:	Rotterdam
Process:	Steam distribution
Medium:	Low (220°C & 3,6 barg) and medium (350°C & 18 barg) pressure steam
Flowmeter:	OPTISONIC 8300 F 6 to 12” **weld in**

<u>Remarks:</u>

- Meters used for billing
- Flow computers mounted in Ex-d boxes

<u>Specific benefits:</u>

- No pressure drop
- 1 % measuring accuracy on massflow, high repeatability
- Large dynamic measuring range
- Maintenance free

Applications: Petrochemical, Refineries

Customer:	Chemical Company
Location:	The Netherlands
Process:	Viton production
Medium:	Emission measurement of ventilation air with chemical gases in variable concentration, to fulfill legal requirement
Flowmeter:	- OPTISONIC 7300: DN 500/20” and DN250/10”, 150lbs, 316L, with SS transducers - OPTISONIC 8300: DN 150/6” and DN200/8”, 150lbs, 316L

<u>Remarks:</u>

- Standard pitot tube measurement not accurate enough (+/-5%)
  - No calibrated measurement
  - Provided issues with regulator
- Issue: Zone 0 in tube → OPTISONIC 8300 solution
  > 1 mm stainless steel window

Applications: Petrochemical, Refineries

OPTISONIC 7300 application Emission measurement

<u>Specific benefits:</u>

- No pressure drop
- Measurement from zero flow
- Independent of gas compesition
- Diagnostics activates the purging system

Applications: Oil and Gas

High pressure gas

Customer:	Statoil and
Localtion:	Norway and
Process:	Unmanned production platform
Medium:	Natural gas
Flowmeter:	OPTISONIC 7300 for high pressure

Remarks:

- Gas lift for optimal oil production
- Up to 431 bar un-decoupled transducer
- For wet gas decoupled transducer up to 257 bar

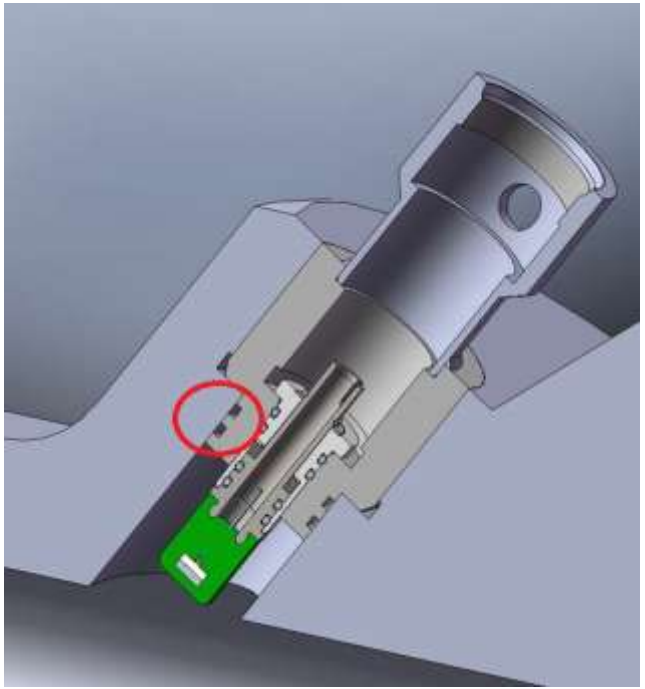
Specific benefits:

- Excellent long term stability
- No influence of chancing process conditions in time (30 years)

Applications: Oil and Gas

High pressure wet gas

- Decoupled transducer
- Max pressure: 257 Bar.
- Space around transducer to avoid acoustic short cut
- Test at wet gas lab NEL in July 2016



Applications: Other industries

Compressed air

Customer: KIA car factory
Location: Czech republic
Medium: Dry compressed air, 600 kPa at 40 ° C
Flowmeter: 2 x OPTISONIC 7300 DN250, PN10
→ Pressure sensor (0 - 10 bar g)
→Temperature sensor (0-100°C)
With output 4-20 mA, connected to the converter for standard volume calculation

<u>Specific benefits</u>:

- Bi-directional flow and quantity measurement of compressed air with conversion to reference conditions
- Measuring range 0 - 20 000 Nm3/h

Other customer with similar applications: Audi car factories, Belgium and Hungary

Applications: Other industries

Compressed air

Customer:	Atlas Copco
Localtion:	Belgium
Process:	R&D labs
Medium:	Dry compressed air
Flowmeter:	OPTISONIC 7300/ ALTOSONIC V12 (CT gasflowmeter)

<u>Remarks:</u>

- Must be accurate to improve the compressors
- Traditionally an orifice plate is/ was used (1%)
- OPTISONIC 7300 with 1% accuracy was tried
  was not accurate enough

<u>Specific Benefit:</u>

- ALTOSONIC V12 was proposed.
- The higher accuracy did pay off (0,5% of MV)
- Very good repeatebility

Applications: Compressed air

DP (differential pressure) flowmeters

Cost of a proper 4”/DN100 orifice flowmeter according to ISO 5167-2 (Orifice plates) for measurement of air, for 1% accuracy (Euro)	
Orifice plate	400
Measurement of orifice plate incl. report	400
Flow pipe 20D, pipe with special tolerances	12.000
Multivariable dP measurement incl. flowcomputer	2000
Temperature sensor + installation	1000
Installation impulse lines + fitting	2000
Total	17.800

Standard CT Ultrasonic Flowmeter without extra calibrations is in line with this investment

Applications: Food industry

Customer:	Suikerunie
Location:	Groningen
Process:	Sugar from sugar beets
Medium:	Biogas, methane concentration: 84 %
Flowmeter:	OPTISONIC 7300 **Biogas** DN150

Remarks:

- Remaining pulp and other bio feedstock collected
- Annual feed in of 100.000 tons of bio feedstock.
- Annual production of 16 million m3 of biogas

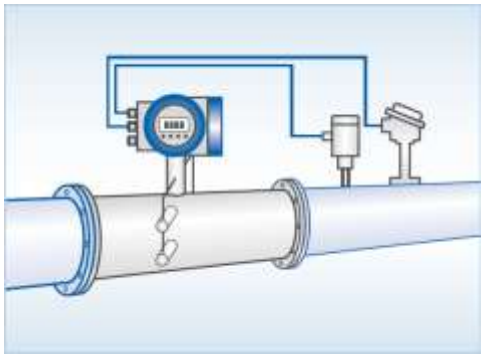
Benefits:

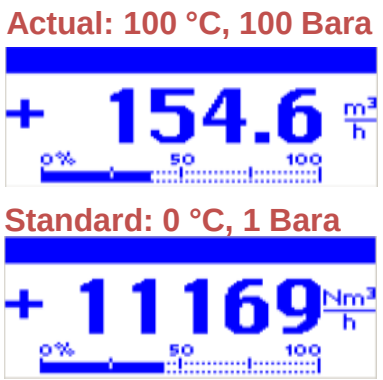
- Measurement of dry and wet biogas with variable compositions
- Integrated temperature and pressure sensor (option)
- Integrated methane content measurement (internal flowcomputer)
- No moving parts and no pressure drop

Applications: Food industry
Converter functions

Integrated functionality

- Methane content calculation with standard temperature sensor
- Optional conversion to standard condition using optional pressure sensor
- Calculation to standard conditions is according to the universal gas law for ideal gases





Applications: Food industry

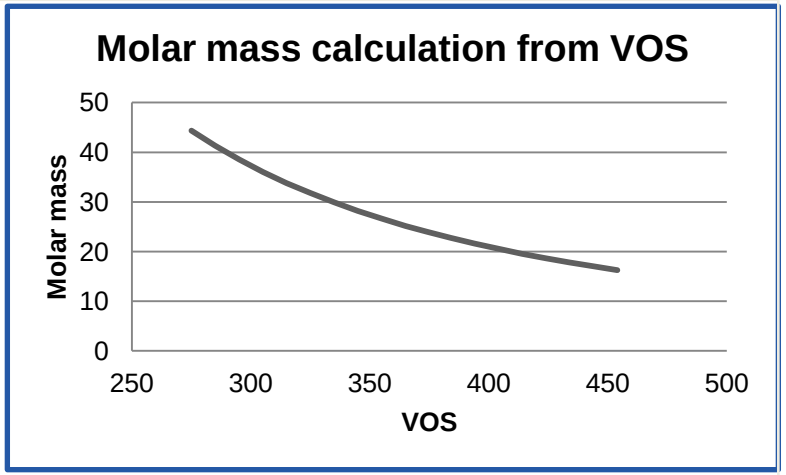
Measurement of methane content

- Molweight can be calculated from VOS and temperature using the following formula:

$$M = \frac{\gamma R T_{actual}}{VoS^2}$$

Molweights: CO_2 = 44, CH_4 = 16

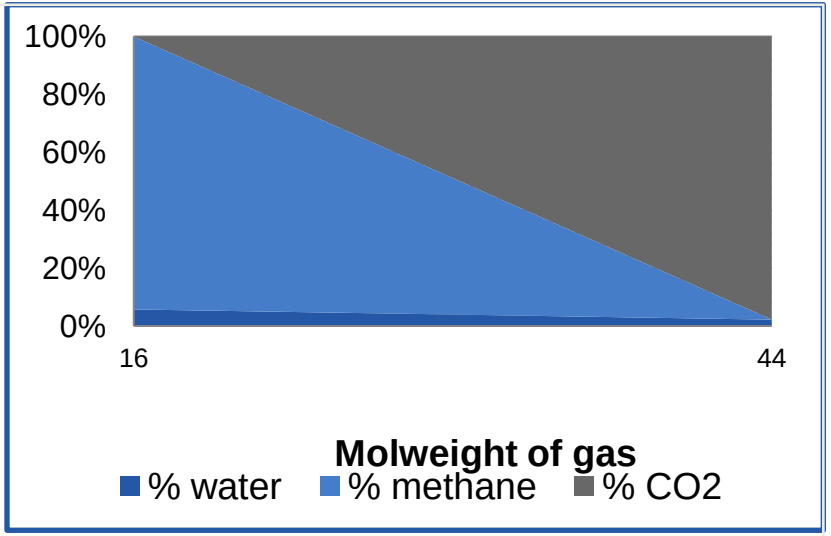
  - γ = adiabatic index, pre-set value into the flowmeter electronics, for the CO_2/CH_4 mixture an average value of 1,31 is entered.
  - R = molar gas constant, approximately 8.3145 J mol-1 K-1.
  - Tactual = Gas temperature in Kelvin, via mA input on the GFC 300
  - VoS = velocity of sound of the gas



Applications: Food industry

Measurement of methane content

- After this the methane content is directly available when biogas is composed of methane and carbon dioxide.
- MW = 16 ➔ 100 % methane, 0 % CO_2
  MW = 44 ➔ 0 % methane, 100 % CO_2 A current output can be set up to indicate
  4 mA at MW=16 and
  20 mA at MW=44
- Accuracy of methane content calculation is +/-2 %



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Flow measurement


Level measurement


Pressure measurement


Temperature measurement

Analysis products


Communications


KROHNE Services


Systems for marine industry


Systems for oil and gas industry

Supplier of innovative measurement solutions for the process industry

Dank u voor uw aandacht